CIRCULAR No. 18.

United States Department of Agriculture,

DIVISION OF VEGETABLE PHYSIOLOGY AND PATHOLOGY.

A NEW WHEAT INDUSTRY FOR THE SEMIARID WEST.[1]

During the past twenty years much interest has been awakened in the subject of crops adapted to semiarid districts, and great results have been obtained in this line. The successful establishment of Kafir corn, Turkestan alfalfa, and awnless brome grass has already been worth many times the cost of the work, and now there is an opportunity to establish in these districts another crop, that is, macaroni wheat, which is quite as important as those mentioned, and which may be profitably grown in the Plains region of the United States far beyond the hundredth meridian.

NATURE OF MACARONI WHEATS.

Macaroni wheats (fig. 1) differ radically from the ordinary bread wheats, and in the field look more like barley than wheat. The heads are flat, compressed, and bearded, the beard often being black; the chaff is usually golden yellow, but sometimes black; and the grains are large, hard, yellowish white, and clear, or, in wheats of the best quality, sometimes translucent. There are also occasionally velvet chaff varieties. In Europe they are known simply as hard wheats, or durum wheats. The grain is much harder than that of the hardest bread wheats, and in the best varieties contains an unusual amount of nitrogen and a correspondingly small amount of starch. The quantity and quality of the gluten make them exceedingly valuable for making macaroni. They are extremely resistant to drought and resist the attacks of leaf rust and smuts to an unusual degree. On the other hand, they will not withstand hard winters, and are usually grown as spring wheats. This fact should not be a strong objection to them, however, for they will behave very differently from the ordinary spring wheats grown in Kansas and Nebraska. South of the thirty-fifth parallel they may be sown in late autumn.

[1] A bulletin on macaroni wheats, prepared by Mr. Carleton, is soon to be issued by the Department. The bulletin will discuss the characteristics of these wheats, their adaptation to our great plains, the demand for such wheats, varieties, and methods of cultivation. The subject is of such immediate importance to farmers in the semiarid plains that it is considered advisable to present briefly the main facts in this advance circular, so that those interested may prepare for sowing this wheat the coming season.—ALBERT F. WOODS, *Chief of Division.*

ADAPTATION FOR CULTIVATION IN THE GREAT PLAINS.

In seeking for crops suitable for semiarid districts, we usually have especially in mind the benefit of the region and not of the crop itself.

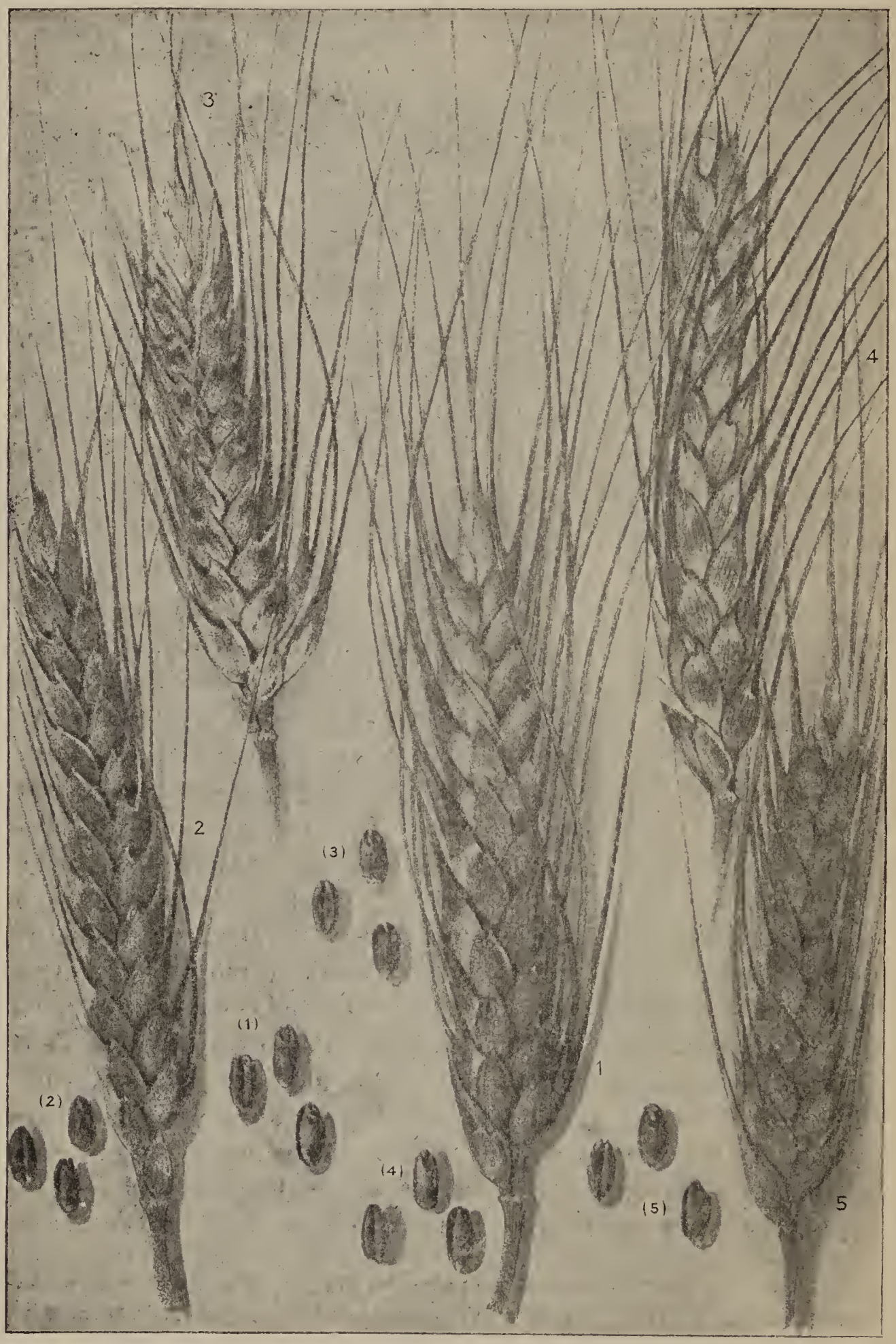

FIG. 1.—Drought-resistant macaroni wheats. 1, Kubanka; 2, Nicaragua; 3, Velvet Don; 4, Black Don; 5, Wild Goose.

In the case of macaroni wheats, however, it is not only true that they *can* be grown in dry districts, but they *must* be grown there

in order to produce the best quality of grain, and up to a minimum of about ten inches annual rainfall, the drier the better, provided the rain falls at the proper time and the soil is of the right kind.

A careful study, made by the writer, of the conditions in east and south Russia show that in both soil and climate they are remarkably similar to those of our Great Plains region. The special climatic features of the Russian region, which are requisite for the production of good macaroni wheats, and which are also characteristic of our own Great Plains, are as follows: (1) A very low annual rainfall (not exceeding 17 inches in east Russia); (2) the occurrence of a very large proportion of that rainfall in the summer months; (3) the nature of the rainfall, which occurs in the form of quick thunderstorms, with few days of mist or fog; (4) corresponding to this, the low atmospheric humidity and large number of days of sunshine; (5) great extremes of temperature, but especially short, intensely hot summers. In the Russian region, however, as a result of the growing of macaroni varieties, the present actual wheat area is characterized by greater extremes of climate than the actual wheat area of the Great Plains. For example, the normal yearly rainfall of the Great Plains at the one hundredth meridian, where wheat growing is at present practically non-existent, because of the lack of drought-resistant varieties, is nearly three inches greater than that for the entire semiarid Volga region, which is one of the principal wheat regions of Russia and produces the finest macaroni wheat that is known.

The soil of the Russian region is a deep black loam, rich in humus and rather strongly alkaline, and exactly the same can be said of the Great Plains region. In the Great Plains, however, wheat has not yet been grown where these features are so striking as in the Russian region. By the use of macaroni varieties the Great Plains wheat area may be and should be extended much farther westward.

On making actual trials of introduced varieties of these wheats the results obtained have abundantly confirmed the conclusion that they are well adapted to our semiarid districts. In 1898 several of the best Russian varieties were obtained by this Department and they have been under trial in cooperation with State Experiment Stations since that time. In all cases so far reported from the semiarid districts these have given results better in all respects than those obtained with standard varieties of the locality grown under the same conditions. At the South Dakota Station in the discouraging season of 1900 they yielded about thirty bushels per acre when other varieties made but two to eight bushels. In North Dakota the yields have been several bushels per acre better than the best bred Fife and Blue Stem wheats. In Utah the average results for 1899 and 1900 were considered better than those of the other varieties.

In all these cases so far as the writer has seen samples the grain was sound, of a clear color, and generally of a good appearance, though the conditions for 1900 were quite damaging to other varieties in North and South Dakota. Trials made by private parties have given equally good results in Kansas, Colorado, Texas, Idaho, Nevada, and California. The varieties Nicaragua, Wild Goose, and Arnautka have been grown sparingly in Texas and the Dakotas for many years independent of government introductions, though the Department introduced Arnautka as early as 1864. At all times the unusual yield and hardiness of these wheats in districts subject to drought have been considered remarkable. The excellent qualities of macaroni wheats for semiarid conditions may be summarized as follows: (1) They are very resistant to leaf rust and smuts; (2) they are extremely resistant to drought; (3) they often ripen a little earlier than other spring wheats; (4) west of the one hundredth meridian they will yield an average of twelve to twenty bushels per acre in many places where wheat growing is now practically an impossibility because of drought; (5) in the larger portions of the Great Plains region they will yield on an average about one-third more per acre than the wheats ordinarily grown there.

The map on page 5 (fig. 2) of this article shows approximately the region in which macaroni wheats will succeed best. It is a somewhat narrow belt extending northward and southward through the Great Plains. Outside of the eastern border of this belt macaroni wheat can be grown, and it may give good yields and resist fungous attacks admirably one hundred to two hundred miles further east, but the quality of the grain will not be what it should. The very best grain will be produced near the one hundredth meridian, and so long as the summer rainfall is as much as eight or ten inches the yield will also be good. West of this belt these wheats will thrive excellently in the larger part of the wheat-growing territory and produce bright, sound grain, but the quality will not be so good because of the lack of nitrogen supply from the soil. It is very important to note that macaroni wheats are, as a rule, sown in the spring. In this country they should be sown in the spring in all territory north of the thirty-fifth parallel. South of that latitude they should be sown October 15 to December 1. In Oklahoma and southern Kansas certain varieties may be found to be adapted to fall sowing also, but until that is well known to be true, it will be safer to sow in the spring.

Probably the most important thing to announce as a result of the Department's investigations is the existence of a market for these wheats. The entire present crop in this country, which will probably be about a hundred thousand bushels, was practically contracted for even before harvest at a good average price. It is being

grown chiefly in North and South Dakota, and consists mainly of the variety Arnautka, but with some Wild Goose also. Heretofore there has been no market for these wheats, and therefore no reason for growing them except for feeding on the farm. Millers

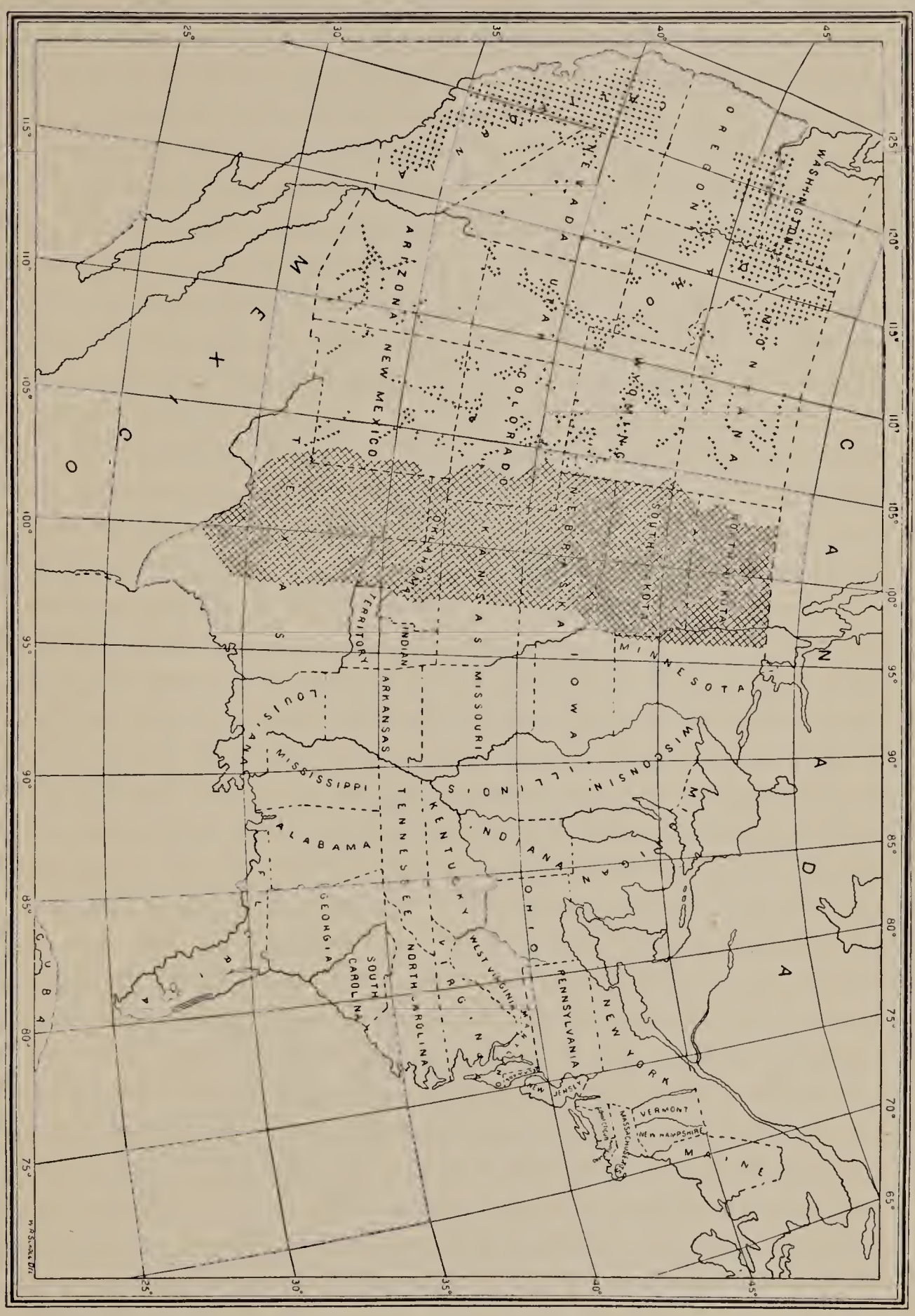

FIG. 2.—Map of the United States showing where macaroni wheat can be grown.

Territory in which macaroni wheat will succeed best, and without irrigation, so long as the summer rainfall is at least 10 inches.

Territory in which macaroni wheat may be grown, but the quality of the grain will not be so good.

have declined to handle them for making bread flour, and macaroni manufacturers have either been unaware of the opportunity of obtaining such wheats or have considered the amount produced too small to justify any preparation for handling them. Now, however, several mills are grinding these wheats, a number of Ameri-

can macaroni factories are desiring the semolina[1] as soon as the mills can furnish them a sufficient amount, and the demand from foreign manufacturers of semolina for American grain of this class is constantly and rapidly increasing. It is only recently that foreign dealers have discovered the good quality of American wheats of this class. As a result, 100,000 tons of Wild Goose wheat have been shipped from Canada to Marseilles since March 1 of this year, as reported to this Department by U. S. Consul Skinner at Marseilles. There is no doubt that fully that amount or even more could be sold from our Great Plains if it had been grown; for Dakota grain of this class is known to be of better quality, as a rule, than the Canadian product.

The Department is in receipt of letters from a number of macaroni manufacturers inquiring for a source of supply of these wheats, and also for the addresses of millers who can prepare the semolina for them; for the factories as a rule do not grind their own wheat. There is a distinct demand for one or two enterprising millers to arrange their machinery for specializing on the preparation of semolina. But above all, there is a strong demand for more of the wheat itself, and farmers of the Great Plains are here urged to put in a much larger acreage the coming season. There is certainty of a market for all that can be grown next year, and at a good price, if the quality is maintained. The writer would also strongly recommend that farmers' clubs and local dealers take pains to place samples of the present crop before the Boards of Trade and Produce Exchanges in our large cities, and have them transmitted also to such organizations in France and Italy, especially to such points as Marseilles, Bordeaux, Genoa, and Naples.

About 15,000,000 pounds of foreign macaroni is imported to this country each year, solely because, being made from true macaroni wheat, it is considered to be of better quality than our domestic macaroni, which is made almost entirely from bread wheats. Moreover, the imported macaroni sells at a much higher price. Of course all the cost of the imported product will be saved to this country if the farmers and millers will furnish our factories with the right kind of material, which they can easily do; and the factories are anxious to have the material.

Although these wheats are considered to be of value chiefly for making macaroni, the idea that they do not make good bread is quite erroneous. A very large amount of macaroni wheat is annually employed in Russia, France, Italy, Spain, Greece, and other Mediterranean regions for making bread, which is considered to be of excellent quality; and the French especially ought to be good

[1] The name of the milled product corresponding to flour, but coarser and gritty.

critics in this matter, for they are the greatest bread-eating people in the world. A small per cent of softer wheat is usually mixed with the macaroni wheat before grinding, however.

The thorough establishment of this new wheat industry will be of the greatest benefit to agriculture in the semiarid plains. A million or more of acres can thus be given to profitable wheat raising which on account of drought have heretofore either been entirely idle or less profitably employed. In a few years time the result ought to be an addition of thirty to fifty million bushels to the annual wheat production of the Great Plains alone. The agricultural area will be extended much farther westward and the necessity of irrigation will thereby be diminished correspondingly.

We ought to produce in the harvest of 1902 at least five million bushels, but it is doubtful if there will be sufficient seed to produce that amount without importations. It is very desirable that at least one-fifth of the present crop be saved for seed. But even that much can produce but a small fraction of five million bushels next year. If the demand for seed is sufficient to justify it, farmers and grain dealers can unite in importing a large amount of seed at reduced cost. Such importations if attempted should be made either from the Azov Sea region of Russia or the region east of the Volga River near the Siberian border. No doubt a considerable amount of seed can be obtained in Canada, though it will not be of so good a quality. In the region from Texas to California Algerian seed might well be used.

It will be advisable in all localities where these wheats have not previously been grown not to sow a very large amount the first year, and to sow two or more of the best recommended varieties if possible. For spring sowing seed should be obtained that was grown pretty well north. The resulting crop is thus likely to ripen earlier and produce grain of better quality.

In this country there are but three varieties that can be drawn upon extensively for seed. These are the Nicaragua in Texas and the Arnautka and Wild Goose in the Dakotas. Other excellent varieties are being grown by the experiment stations but on an experimental scale. Of these three varieties, Arnautka is likely to be the best. It is a Russian variety which probably came originally from the Azov Sea region. In Russia, so far as the writer's investigations have gone, Gharnovka from the Azov Sea region and Pererodka or Kubanka from the Siberian border are the best, though Beloturka ranks well also. Russian macaroni wheats are the best in the world, as shown by numerous comparative tests and analyses and the fact that they are chiefly used in the foreign factories. In a number of chemical analyses made by this Department their gluten content is shown to be nearly fifty per cent greater than that of

varieties from Algeria and Argentina. This is probably to be accounted for by the unusual humus content of the soil in the Russian region.

Comparative field tests of various varieties of macaroni wheats introduced by this Department are being continued at several of the State Experiment Stations this year. Experiments in cooperation with this Department have been inaugurated at the South Dakota Station, in which 60 to 75 varieties from various countries are employed, mostly on a small scale. Similar experiments will be conducted with one or two other States of the plains next year. These experiments are to be carried on in a most thorough manner, and will soon indicate by their results which varieties are the best for the particular district. The methods of cultivation of macaroni wheats are much the same as should be observed in growing any other wheats in semiarid districts. No doubt in many instances, however, attempts will be made to establish these wheats where it has been impossible to grow other wheats profitably on account of the extreme drought. In such cases, of course, every means possible for conserving moisture should be employed. All plowing should be done very early—the preceding summer in cases of spring sowing—and the ground afterward cultivated lightly several times before seeding. These wheats invariably give best results on new ground. They should be sown at the rate of about a bushel and a peck to the acre. They do not stool extensively, but produce fine heads and grain, if sown only moderately thick. Seeding should always be done with the drill, and the drills should be deep and always run east and west. Macaroni wheats require an abundance of hot sunshine near harvest time. Continued humidity of the atmosphere is fatal to them. They should be pretty well ripened before cutting, and should not be harvested in damp weather if avoidable.

MARK ALFRED CARLETON,
Cerealist.

Approved:
JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *June 28, 1901.*